If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match.
The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.
Hard copies of all signed, official, C-A Operating Procedures are kept on file in the C-A ESHQ Training Office, Bldg. 911A.

C-A OPERATIONS PROCEDURES MANUAL

7.1.58 Regeneration of Warm Turbines "B" Train

Text Pages 2 through 10

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Approved: _____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

S. Sakry

7.1.58 Regeneration of Warm Turbines "B" Train

1. Purpose

To provide instructions for regenerating the warm turbine "B" train on the RHIC 25 kW helium refrigerator. The procedure is used to warm the turbines and remove moisture. The procedure contains the following sections:

5.1 Regeneration of Turbines 1B/2B Only.
5.2 Regeneration of Turbines 3B/4B Only.
5.3 Regeneration of HX3B Only.
5.4 Regeneration of Turbines 1B/2B, 3B/4B and Heat Exchanger HX3B.

2. Responsibilities

2.1 The Shift Supervisor, or an Operator designated by the Shift Supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log and in the Cryogenic Valve Log.

2.2 Should a problem arise in the process of the procedure, the Shift Supervisor shall report to the Technical Supervisor for instructions before continuing.

3. Prerequisites

3.1 The Operator shall be trained by the Shift Supervisor.

3.2 Operator shall be familiar with the refrigerator P&ID drawing 3A995009, the physical location of components on the refrigerator, and the refrigerator control pages found on the CRISP control system. Valves and equipment mentioned in this procedure will be found on drawing 3A995009.

3.3 The regeneration skid must be available for use.

4. Precautions

4.1 If there is liquid helium in the refrigerator pots, all personnel entering the refrigeration wing of 1005R must be ODH Class 1 qualified, have a Personal Oxygen Monitor (POM) and carry an emergency escape pack, if the refrigerator is operating.

5. Procedure

5.1 Turbines 1B/2B Only

_____ 5.1.1 Date_____.

_____ 5.1.2 Ensure mechanical brakes are installed per C-A-OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.1.3 Ensure the following valves are closed:

Process:

H728A____
H738M____

Other:

H407M____ H400M____
H266M____ H373M____
H9168M____

_____ 5.1.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.1.5 Ensure that the regulator PR9166M has been replaced with the spool piece.

_____ 5.1.6 Open the following valves:

H405M____ H243M____
H703M____ H730A____ (Vanes)
H9166M____ H739A____ (Vanes)
H773M____

_____ 5.1.7 Close regen manifold bypass valve H9100M.

_____ 5.1.8 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.1.9 Monitor temperature at TI737H.

_____ 5.1.10 When TI737H reaches 290^{o}K, continue to regenerate for at least one hour. Hygrometer reading must be –20^{o}C to –40^{o}C and improving less than 0.5^{o}C/hour.

_____ 5.1.11 Turn off regen skid pre-heater.

_____ 5.1.12 Open bypass valve H9100M.

_____ 5.1.13 Close the following valves:

H739A____	H9166M____
H730A____	H703M____
H243M____	H405M____
H773M____	

_____ 5.1.14 Secure the regen skid per C-A OPM 7.1.36.

_____ 5.1.15 Install regulator PR9166M.

_____ 5.1.16 Purge expander 1B/2B per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

5.2 Turbines 3B/4B Only

_____ 5.2.1 Date_____.

_____ 5.2.2 Ensure mechanical brakes are installed on turbines 3B/4B per C-A OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.2.3 Ensure the following valves are closed:

Process:

H752A____
H780A____
H760M____

Other:

H429M____	H9174M____
H377M____	H427M____
H6182M____	H378M____

_____ 5.2.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.2.5 Ensure that regulator PR9172M has been replaced with the spool piece.

_____ 5.2.6 Open the following valves:

H428M____	H415M____
H777M____	H754A____ (Vanes)
H9172M____	H757A____ (Vanes)
H778M____	

_____ 5.2.7 Close regen skid bypass valve H9100M.

_____ 5.2.8 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.2.9 Monitor turbine 4B outlet temperature at TI761H.

_____ 5.2.10 When TI761H reaches 290^{o}K, continue to regenerate for at least one hour. Hygrometer reading must be –20^{o}C to –40^{o}C and improving less than 0.5^{o}C/hour.

_____ 5.2.11 Turn off regen skid pre-heater.

_____ 5.2.12 Open bypass valve H9100M.

_____ 5.2.13 Close the following valves:

H757A____	H9172M____
H754A____	H777M____
H415M____	H428M____
H778M____	

_____ 5.2.14 Secure the regen skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.2.15 Install regulator PR9172M.

_____ 5.2.16 Purge expanders 3B/4B per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

5.3 Heat Exchanger HX3B Only

_____ 5.3.1 Date_____.

_____ 5.3.2 Ensure mechanical brakes are installed on turbines 1B/2B and 3B/4B per C-A OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.3.3 Ensure the following valves are closed:

Process:

H730A____ (Vane)	H776M____
H739A____ (Vane)	H746M____
H754A____ (Vane)	H826M____
H757A____ (Vane)	H780A____ (Physically Block)
H744A____	H728A____ (Physically Block)
H741M____	

Other:

H429M____	H9174M____
H6182M____	H400M____
H377M____	H373M____

_____ 5.3.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.3.5 Ensure that regulator PR9172M has been replaced with the spool piece.

_____ 5.3.6 To avoid spinning turbines, ensure pressure in HX3A is approximately equal to pressure in expanders (with 0.5 atm).

_____ 5.3.7 Open process valves H738M____ and H752A____ (air line must be jumpered at valve).

_____ 5.3.8 Open the following valves:

H428M____	H773M____
H777M____	H243M____
H9172M____	

_____ 5.3.9 Close regen skid bypass valve H9100M.

_____ 5.3.10 If heat exchanger is cold, turn on regen skid pre-heater.

_____ 5.3.11 Monitor regen return line at valve H773M.

_____ 5.3.12 When frost has cleared from the regen return line, continue to regen for at least one hour. Hygrometer reading must be $-20^{o}C$ to $-40^{o}C$ and improving less than $0.5^{o}C$/hour.

_____ 5.3.13 Turn off regen skid pre-heater.

_____ 5.3.14 Open bypass valve H9100M.

_____ 5.3.15 Close the following valves:

H243M____ H777M____
H773M____ H428M____
H9172M____

_____ 5.3.16 Install regulator PR9172M.

> **Note:**
> **If the refrigerator is operating, heat exchanger and turbines are normally purged separately due to heat transfer between HX3 heat exchangers.**

_____ 5.3.17 Purge heat exchanger HX3B per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.3.18 Purge expanders 1B/2B per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.3.19 Purge expanders 3B/4B per C-A OPM 7.1.27, "Warm Expander Purge Procedure."

_____ 5.3.20 Ensure the following process valves are closed:

H752A____ (Return air line to normal)
H738M____

_____ 5.3.21 Secure regen skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

5.4 Turbines 1B/2B, 3B/4B and Heat Exchanger HX3B

> **Note:**
> **This section is normally completed only when the refrigerator is shut down due to heat transfer between HX3 heat exchangers.**

_____ 5.4.1 Date_____.

_____ 5.4.2 Ensure that mechanical brakes are installed on turbines per C-A OPM 7.1.26, "Expander Brake System Installation and Removal."

_____ 5.4.3 Ensure the following valves are closed:

Process:

H730A____	H826M____
H746M____	H760M____
H776M____	H780A____

Other:

H407M____	H740M____
H266M____	H9172M____
H9168M____	H427M____
H773M____	H378M____
H745M____	

_____ 5.4.4 Start the regeneration (regen) skid per C-A OPM 7.1.36, "Regeneration System Normal Operation."

_____ 5.4.5 Ensure that the regulator PR9166M has been replaced with the spool piece.

_____ 5.4.6 To avoid spinning turbines, ensure pressure in HX3B is approximately equal to expander pressure (within 0.5 atm).

_____ 5.4.7 Open process valves H738M____ and H752A____ (Air line must be jumpered at valve).

_____ 5.4.8 Open the following valves:

H405M____	H730A____ (Vanes)
H703M____	H739A____ (Vanes)
H9166M____	H754A____ (Vanes)
H778M____	H757A____ (Vanes)
H415M____	

_____ 5.4.9 Close regen manifold bypass valve H9100M.

_____ 5.4.10 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.4.11 Monitor turbine 4B outlet temperature at TI7361H.

_____ 5.4.12 When T7361H reaches 290^{o}K, continue to regenerate for at least one hour. Hygrometer reading must be –20^{o}C to –40^{o}C and improving less than 0.5^{o}C/hour.

_____ 5.4.13 Turn off regen skid pre-heater.

_____ 5.4.14 Open bypass valve H9100M.

_____ 5.4.15 Close the following valves:

H757A____ (Vane)	H778M____
H754A____ (Vane)	H9166M____
H739A____ (Vane)	H703M____
H730A____ (Vane)	H405M____
H415M____	

_____ 5.4.16 Install regulator PR9166M.

_____ 5.4.17 Purge expanders 1B/2B, 3B/4B and heat exchanger HX3B per C-A OPM 7.1.27, “Expander Purge Procedure.”

_____ 5.4.18 Close the following process valves:

H752A____ (Return air lines to normal)
H738M____

_____ 5.4.19 Secure regen skid per C-A OPM 7.1.36, “Regeneration System Normal Operation.”

6. Documentation

6.1 The check-off lines are for place keeping only. The procedure is not to be initialed or signed, it is not a record.

6.2 The Shift Supervisor shall document the completion of the procedure in the Cryogenics Control Room Log.

7. References

7.1 C-A OPM 7.1.26, “Expander Brake System Installation and Removal”

7.2 C-A OPM 7.1.36, “Regeneration System Normal Operation”

7.3 C-A OPM 7.1.27, “Expander Purge Procedure”

8. Attachments

None